UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2014/2015

COURSE NAME : PHYSICAL CHEMISTRY

COURSE CODE : DAK 10303

PROGRAMME : 1 DAK

EXAMINATION DATE : DECEMBER/ JANUARY 2015

DURATION : 2 HOURS 30 MINUTES

INSTRUCTION : A) ANSWER **ALL** QUESTIONS

B) ANSWER **TWO (2)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

SECTION A

Q1 (a) Estimate the mass of H_2 gas in a balloon that holds about 2.69×10^{22} molecules of the gas. (Relative atomic mass= H, 1 N_A=6.022 X 10^{23}).

(7 marks)

(b) Concentrated sulphuric acid has a density of 1.84 g /cm^3 and contains 98% (by mass) of H_2SO_4. (Relative atomic mass= H, 1: S, 32: O, 16)

(i) Calculate the molarity of concentrated sulphuric acid

(15 marks)

(ii) What volume of concentrated sulphuric acid is needed to prepare 1.0 L of 0.5 M H_2SO_4

(4 marks)

(iii) Calculate the concentration (g/dm^3) of 0.5 M sulphuric acid

(4 marks)

Q2 The reaction between ethyl ethanote and potassium hydroxide is a second order reaction

$$CH_3COOC_2H_5 + KOH \rightarrow CH_3COOK + C_2H_5OH$$

(a) Aqueous solution containing equimolar amount of ethyl ethanoate and potassium hydroxide were mixed at 298 K . Initially, the concentration of KOH used was 10.0 mol dm^{-3}. At 300 s, the concentration of the alkali remaining was 6.25 mol dm^{-3}.

(i) Calculate the rate constant
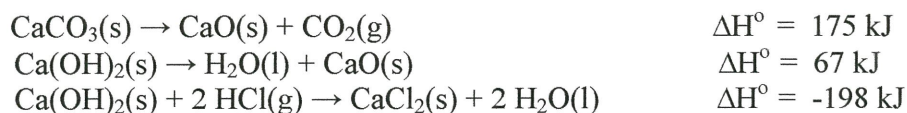
(6 marks)

(ii) Calculate the half life

(4 marks)

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(b) Explain the effect of

    (i)   Temperature on the rate constants

                (6 marks)

    (ii)   Catalyst on a chemical reaction

                (6 marks)

    (iii)   Besides temperature and the presence of a catalyst, give three other factors that affect the rate of a chemical reaction.

                (3 marks)

SECTION B

Q3   (a) Solve $\Delta H°$ for the following reaction:

$$CaCO_3(s) + 2\ HCl(g) \rightarrow CaCl_2(s) + H_2O(l) + CO_2(g)$$

Given the following information

$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$	$\Delta H° = 175$ kJ
$Ca(OH)_2(s) \rightarrow H_2O(l) + CaO(s)$	$\Delta H° = 67$ kJ
$Ca(OH)_2(s) + 2\ HCl(g) \rightarrow CaCl_2(s) + 2\ H_2O(l)$	$\Delta H° = -198$ kJ

                (10 marks)

(b) (i) In an isothermal process, 3700 J of work is done by an ideal gas. Find the amount of heat added to the system

                (3 marks)

    (ii) Explain your answer

                (12 marks)

Q4   (a) Ksp for the reaction $BaSO_4(s) \rightarrow Ba^{2+}(aq) + SO4^{-2}(aq)$ is 1.1×10^{-10}

$\Delta G_f°$ for $Ba^{2+}(aq)$	-560.8 kJ/mol
$\Delta G_f°$ for SO_4^{-2}	-744.5 kJ/mol
$\Delta G_f°$ for $BaSO_4(s)$	-1362.3 kJ/mol

Based on the information above

    (i)   Use thermodynamic data to estimate $\Delta G°$ for this reaction

                (5 marks)

    (ii)   Solve the values of K from the information given

                (8 marks)

(c) The equilibrium constant for the dissociation of PCl_5 (g) to form $PCl_3(g)$ and $Cl_2(g)$ is 0.040 dm^{-3} at 250°C. An equilibrium mixture contains 0.20 mol PCl_3 (g) and 0.12 mol Cl_2 (g) in a 4000 cm^3 container at 250 °C. Calculate the mass of PCl_5 in the container. (Relative atomic mass = P, 31 : Cl, 35.5)

(10 marks)

Q5 (a) A solution is prepared by dissolving 40.0 g of sucrose, $C_{12}H_{22}O_{11}$, in 250 g of water at 25°C. Estimate the vapour pressure of solution if the vapour pressure of water at 25°C is 23.76 mmHg (Relative atomic mass= C, 12: H, 1: O, 16)

(10 marks)

(b) 0.200 mole of a non –volatile solute in 125 g of benzene (C_6H_6) produces a solution that has a boiling point of 84.2°C. Calculate the boiling point elevation of the pure solvent. (Relative atomic mass= C: 12, H : 1 , O : 16) (K_b for benzene = 2.53°C m^{-1})

(12 marks)

Q6 (a) In the vapour state, phosphorus exists as P_4 molecules. Calculate the density in (g dm^{-3}) of phosphorus vapour at 310 °C and 775 mmHg. (Relative Atomic Mass of P: 31) (Gas Constant, R: 8.314 JK^{-1} mol^{-1} / 0.08206 atm $dm^3K^{-1}mol^{-1}$

(13 marks)

(b) Explain 5 kinetic theory of gases based on five basic assumptions

- END OF QUESTION -